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DETERMINATION OF AEROSOL CONTENT  
IN THE ATMOSPHERE FROM  
LANDSAT DATA

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CONTENT IN THE ATMOSPHERE FROM LANDSAT  
Progress Report, 1 May - 31 Jul. 1976

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## ACCOMPLISHMENTS

In this sixth reporting period, Volz measurements were made at San Diego and the Salton Sea; Volz data and Landsat prints were received for some of the new test sites; the analysis of the raw data CCT's was continued, and some theoretical calculations were made.

### Volz Measurements

In this period it was possible to obtain Volz data for two of the five Landsat 2 overpasses at the San Diego test site. Three trips were made to the Salton Sea test site, and data were obtained on each occasion. Data were also obtained for three of the five Landsat 1 overpasses at San Diego in this period. The measured Volz data are given in Table 1.

TABLE 1. Volz Data

Date	Aerosol Optical Thickness	Aerosol Content
<u>Landsat 2</u>		
<u>San Diego</u>		
6-4-76	.272	1.28 N
6-22-76	.197	.92 N
<u>Salton Sea</u>		
5-16-76	.202	.95 N
6-3-76	.280	1.31 N
6-21-76	.184	.86 N
<u>Landsat 1</u>		
<u>San Diego</u>		
5-8-76	.226	1.06 N
7-1-76	.210	.99 N
7-19-76	.275	1.29 N

## New Test Sites

Of the eleven new test sites, five NOAA-EPA sites have to date reported Volz observations for March and April, and two have made no report yet; the four LACIE sites have reported data for only May so far (these sites did not start Volz observations until May). For the dates reported, Volz measurements were possible for 15 of 34 overpasses. Black and white Landsat prints have been received for many overpasses under our EROS standing order, although prints for some overpasses for which Volz data were obtained have not been received (due presumably to the 50% minimum cloud cover restriction). These missing prints will be ordered from the Landsat Standard catalogs, which unfortunately are presently published some months after data acquisition. The March catalog was received in mid-July.

## Raw Data Tapes

The problems encountered with the raw data tapes discussed in Progress Report No. 5 appear to have been resolved. Only one of the three "raw" tapes sent to us was in fact "raw"; the other two apparently were "corrected" tapes wrongly labeled as "raw". New sets of raw and corrected tapes for the three overpasses were received and analyzed. Some problems were encountered due to differences in the registration in two of the three sets of corrected and raw tapes, i. e., a given geographical feature was located a different number of scan lines from the start on each tape of a particular scene.

The results of comparing the raw and corrected tapes for the three overpasses are given in Table 2.

TABLE 2.

Date	Channel	Radiances (mw/cm <sup>2</sup> /μm/sr)	
		Corrected	Raw
3-30-75	MSS 4	3.16 (3.27)*	3.14
	5	1.68 (1.43)	1.65
	6	.92 (.72)	.90
	7	.61 (.87)	.43
5-5-75	MSS 4	4.21	4.25
	5	2.21	2.26
	6	1.55	1.60
	7	1.19	1.07
11-18-75	MSS 4	3.17	3.11
	5	2.01	2.00
	6	1.27	1.26
	7	.74	.73

\* The parenthetical values were obtained from an earlier corrected tape.

From the data for these three overpasses, it appears that only MSS 7 shows a difference between the radiances determined from the raw and corrected tape. A more significant difference is observed between the early corrected tape received from EROS and the later corrected tape received from GSFC. The later tape gives more reasonable results, with the MSS 7 radiance being less than the MSS 6 radiance. The radiance values in Table 2 have been normalized to  $\mu = .45$ , and plotted against aerosol content in Figure 1. The only significant improvement is in MSS 7 for 3-30-75. Two more raw tapes for 10-31-75 and 12-6-75 have been requested, and will be analyzed to confirm these small differences between the raw and corrected tapes.

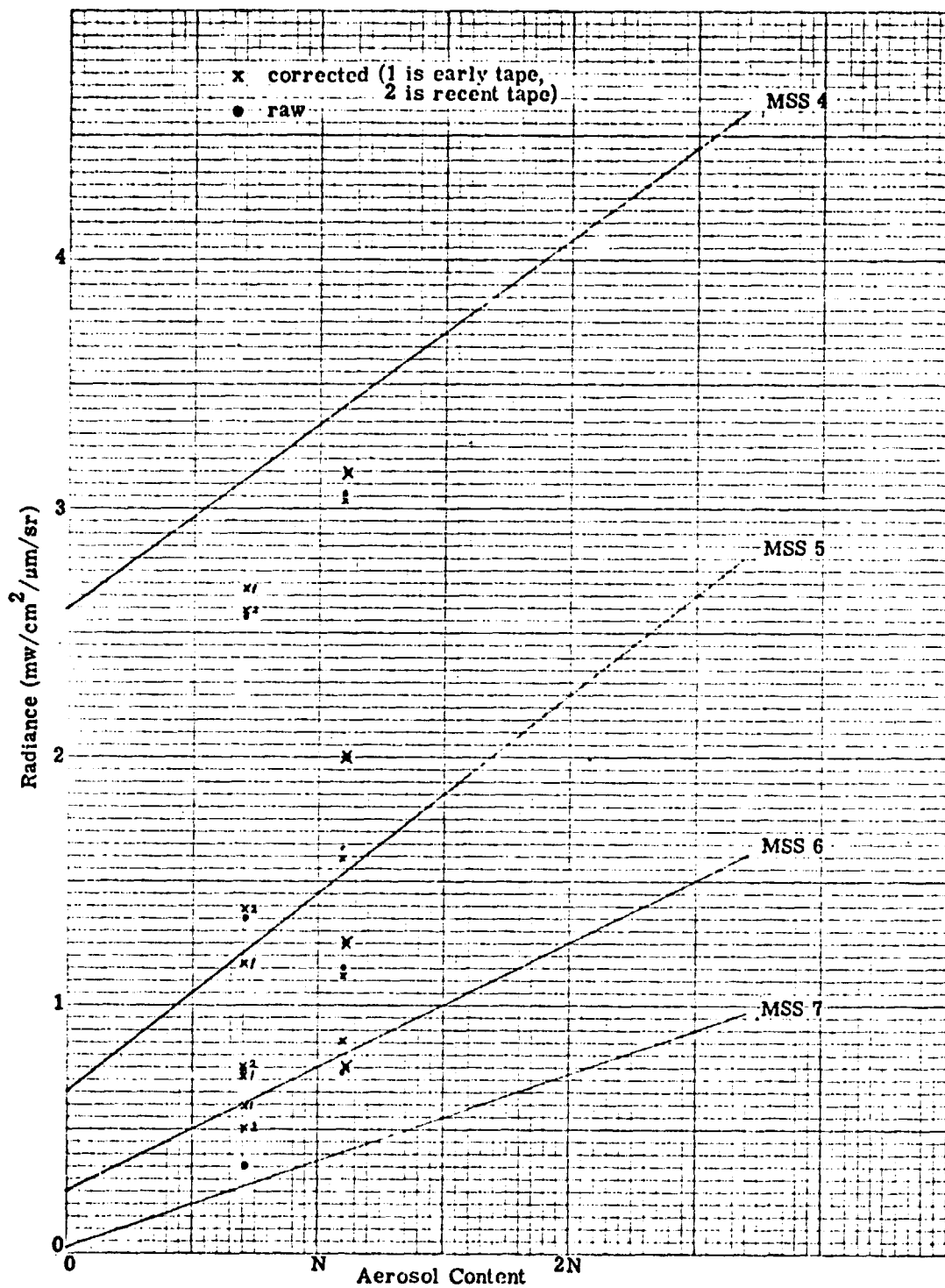


Figure 1. Comparison of Raw and Corrected Data.

## Landsat Data

Digital data for one Landsat 2 overpass at the Salton Sea and for one Landsat 1 overpass at San Diego have been received and analyzed. Eleven other CCT's are on order.

The Salton Sea data (1. 13 N) are included in the plot of the Landsat 2 data in Figure 2. The radiance values are similar to the previous data, with MSS 5 again showing a larger radiance than expected.

The San Diego Landsat 1 data for 4-20-76 are shown in the plot (Figure 3) of Landsat 1 data analyzed in the present program. These are the first San Diego Landsat 1 data analyzed in this program, and tend to show slightly lower radiance values than found in our original Landsat 1 program. More points are needed to determine if this difference is significant.

## Theoretical Calculations

Calculations were made with the Dave program to determine the effect of changing the real part ( $n$ ) of the refractive index on the radiance-aerosol content relationship. In all the previous calculations  $n = 1.5$  has been used as being representative of typical atmospheric aerosols (K. Bullrich, Advances in Geophysics 10, 99, 1964). This value will decrease when the humidity increases above about 80% due to condensation on the aerosols. The value  $n = 1.4$  is reached at about 98% humidity. Thus calculations for  $n = 1.4$  have been made since this is probably an extreme variation of refractive index. The results for  $n = 1.4$  are shown in Figure 4 in comparison with the previous calculations for  $n = 1.5$ . It is seen that this change in refractive index produces a small but significant change in the radiance values. This was not expected since the scattering function for a distribution of aerosol sizes was thought to be relatively insensitive to the refractive index (e.g. Bullrich, 1964). Little work appears to have

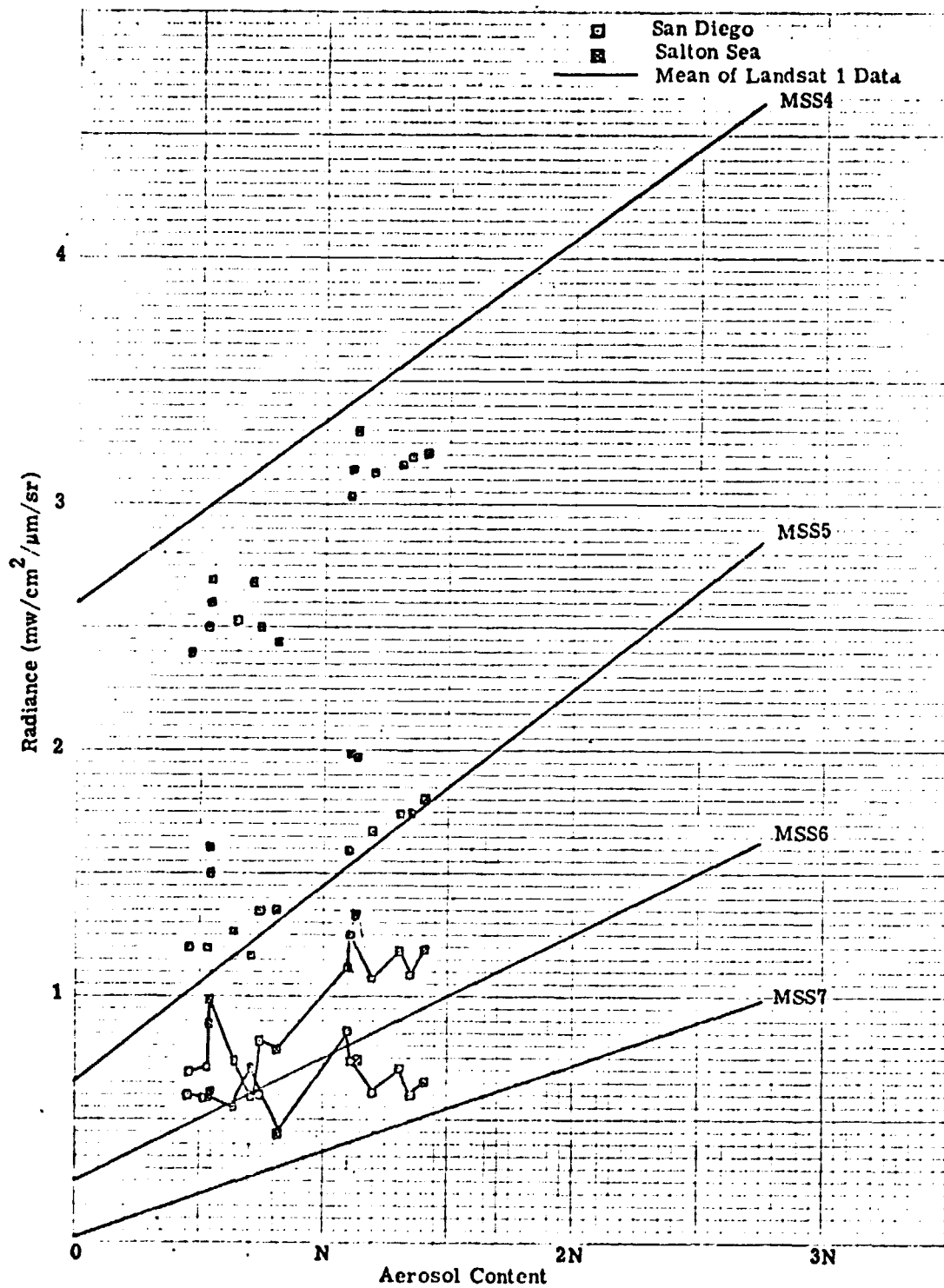


Figure 2. Radiance vs. Aerosol Content (Landsat 2)



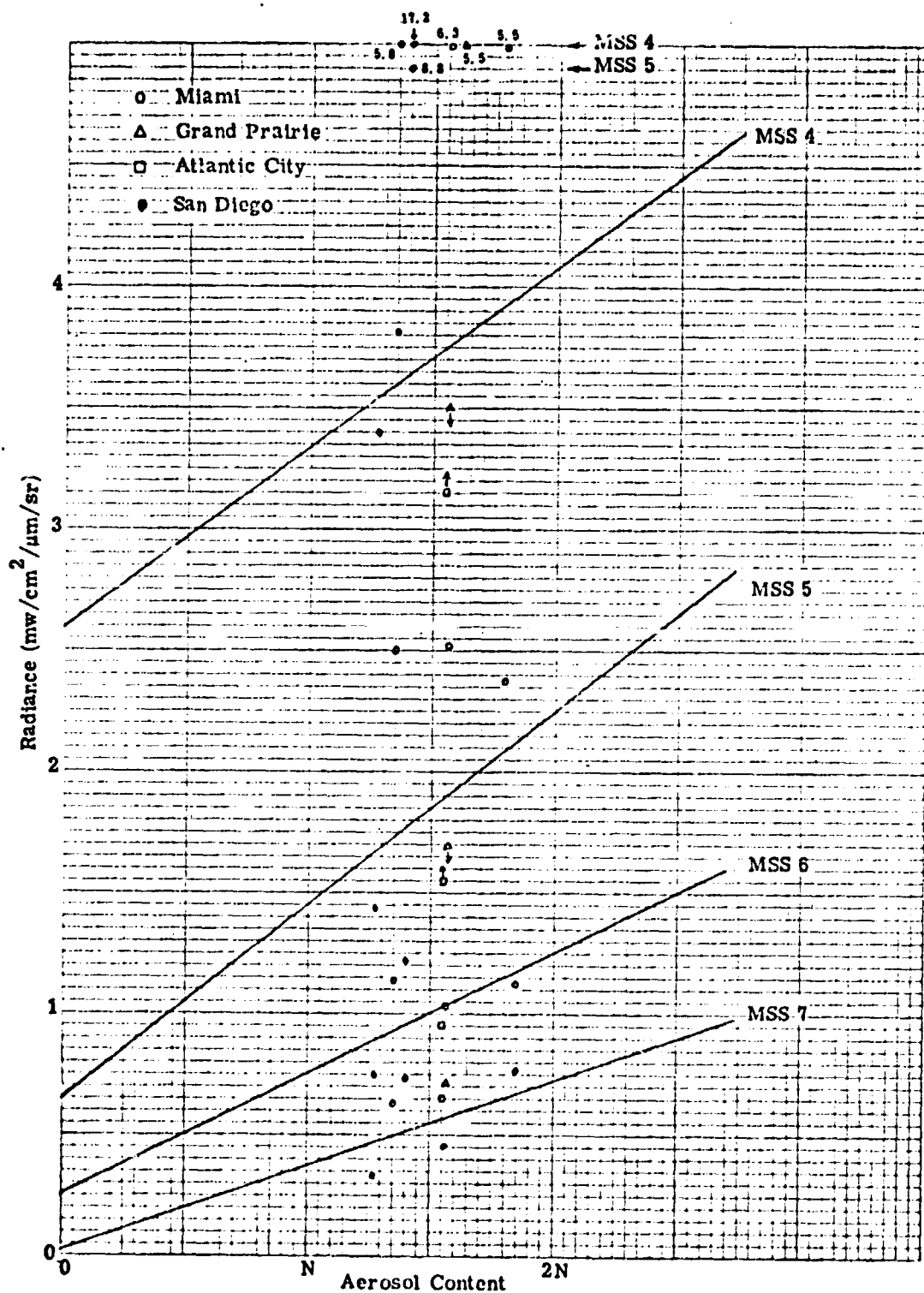


Figure 3. Radiance vs. Aerosol Content (Landsat 1)

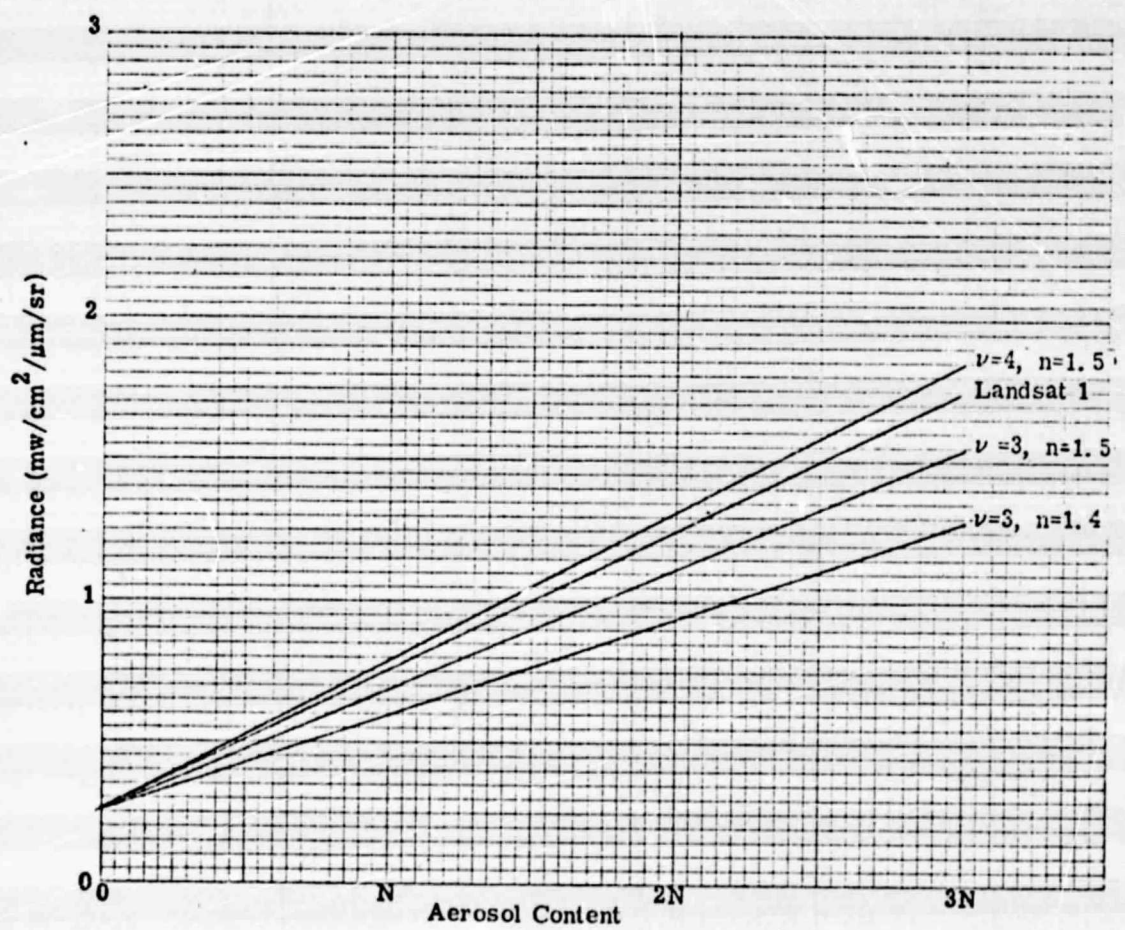


Figure 4. Radiance vs. Aerosol Content for MSS 6

been done to determine the range of values for the refractive index of aerosols, but Bullrich estimates that it will generally be in the range 1.49 to 1.59, for normal humidities.

### Plans

Volz data will be taken at San Diego and the Salton Sea, weather permitting. Volz data and Landsat data from the new test sites will be analyzed as received.

### SIGNIFICANT RESULTS

There are no significant results to report in this period.

### PUBLICATIONS

No publications were made in this period.

### RECOMMENDATIONS

No changes in the program appear necessary at the present time.

## **PROBLEMS**

The analysis of the raw tapes has continued to take more time than anticipated.

The delay in receipt of the Landsat Standard Catalogs will cause delays in obtaining and analyzing some of the CCT's.